

WHAT IS CLAIMED IS:

1. An airflow sensor for detecting airflow within an air handling system, the airflow sensor comprising:

a housing defining an internal compartment and a top face, the top face forming an opening;

a flexible substrate having circuitry traces, a front, and a back, the substrate being disposed within the compartment such that the back is exposed relative to the opening in the top face; and

electrical components electrically connected to the circuitry traces and extending from the front of the substrate opposite the opening, the electrical components including:

a first, heated temperature sensor,

a second, baseline temperature sensor,

wherein the first and second temperature sensors are spaced from one another;

wherein during use airflow interfaces with the back of the substrate to cool the first temperature sensor, the extent of cooling as compared to the second temperature sensor being indicative of airflow, and further wherein the airflow sensor is configured to limit accumulation of debris along the back of the flexible substrate.

2. The airflow sensor of claim 1, wherein the top face forms a lip otherwise defining the opening, the opening including an outer dimension less than that of the substrate such that upon final assembly, the back of the substrate abuts the lip.

3. The airflow sensor of claim 2, wherein the airflow sensor is adapted such that upon final assembly, at least a portion of the back of the substrate is substantially flush with the lip.
4. The airflow sensor of claim 1, wherein the housing is configured to be selectively secured to an ultraviolet air treatment device.
5. The airflow sensor of claim 4, wherein the housing includes a plurality of legs extending opposite the top face, the legs configured for attachment to the ultraviolet air treatment device.
6. The airflow sensor of claim 1, wherein the flexible substrate is a Kapton flexible circuit.
7. The airflow sensor of claim 1, wherein the back of the flexible substrate is substantially smooth.
8. The airflow sensor of claim 1, wherein the circuitry traces include a first trace electrically connecting the first and second temperature sensors to a common node.
9. The airflow sensor of claim 8, wherein the first trace extends in a serpentine fashion between the first and second temperature sensors.
10. The airflow sensor of claim 1, wherein upon final assembly, the first and second temperature sensors are aligned with the opening.
11. The airflow sensor of claim 1, wherein the first and second temperature sensors are spaced by approximately 0.5 inch.

12. The airflow sensor of claim 11, wherein the housing defines an outer diameter of approximately 1.2 inches.
13. The airflow sensor of claim 1, wherein the electrical components further include a heating element positioned in close proximity to the first temperature sensor for heating the first temperature sensor.
14. The airflow sensor of claim 13, wherein the heating element is positioned between the first and second temperature sensors.
15. The airflow sensor of claim 13, wherein the first and second temperature sensors are thermistors.
16. The airflow sensor of claim 1, further comprising:
insulating material disposed within the compartment below the flexible substrate such that the electrical components are embedded within the insulating material.
17. An airflow sensor system for detecting airflow within an air handling system, the sensor system comprising:
an airflow sensor including:
a first, heated temperature sensor,
a second, baseline temperature sensor; and
a processor electrically connected to the temperature sensors, the processor adapted to:
monitor signals from the temperature sensors,
determine current temperature readings at the temperature sensors
based upon the monitored signals,

determine an airflow state within the air handling system based upon a difference between the determined current temperatures (DT) and a rate of change in DT.

18. The sensor system of claim 17, wherein the processor is further adapted to:

generate a temperature rate of change value based upon a difference between DT and a lag temperature differential value; and compare the temperature rate of change value with at least one threshold value to detect the presence of airflow.

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19. The airflow system of claim 18, wherein the processor is further adapted to generate the lag temperature differential value as a function of DT and a sensor lag parameter.

20. The sensor system of claim 19, wherein the processor is further adapted to:

continuously update the current temperature readings; and continuously update DT, the temperature rate of change value, and the lag temperature differential value each time the current temperature readings are updated.

21. The sensor system of claim 20, wherein the updated temperature rate of change value is based upon the updated DT and the updated lag temperature differential value.

22. The sensor system of claim 21, wherein the updated lag temperature differential value is based upon a previous lag temperature differential value.

39. The method of claim 38, wherein the first threshold value is a positive number, and further wherein determining the airflow state further includes:
designating airflow as being off when the temperature rate of change value is less than the first threshold value.
40. The method of claim 38, wherein the second threshold value is a negative number, and further wherein determining the airflow state further includes:
designating that airflow is on when the temperature rate of change value is less than the second threshold value.
41. The method of claim 33, wherein determining the airflow state further includes:
comparing DT with a reference parameter.
42. The method of claim 41, wherein the reference parameter is indicative of operational conditions when the air handling system transitions from an airflow off state to an airflow on state.
43. The method of claim 42, further comprising:
updating the reference parameter with a current value upon determining that the air handling system has transitioned from an airflow off state to an airflow on state.
44. The method of claim 30, wherein determining the airflow state includes:
generating a current temperature differential value based upon a difference between the determined current temperature readings;
and
comparing the current temperature differential value with a threshold value;

23. The sensor system of claim 18, wherein the processor is further adapted to compare the temperature rate of change value with a first threshold value to designate that airflow is not present and with a second threshold value to designate that airflow is present.

24. The sensor system of claim 23, wherein the first threshold value is a positive number, whereby if the temperature rate of change value is greater than the first threshold value, the processor is adapted to designate that airflow is not present.

25. The sensor system of claim 23, wherein the second threshold value is a negative number, whereby if the temperature rate of change value is less than the second threshold value, the processor is adapted to designate that airflow is present.

26. The sensor system of claim 18, wherein the processor is further adapted to designate that airflow is not present based upon a comparison of DT with a reference parameter.

27. The sensor system of claim 26, wherein the reference parameter is indicative of operational conditions when the air handling system transitions from an airflow off state to an airflow on state.

28. The sensor system of claim 27, wherein the processor is further adapted to update the reference parameter with a current value upon determining that the air handling system has transitioned from an airflow off state to an airflow on state.

29. The sensor system of claim 17, wherein the processor is further adapted to generate a current temperature differential value based upon a difference

between the determined current temperatures and to designate that airflow is present when the current temperature differential value is less than a threshold value.

30. The sensor system of claim 17, wherein the sensor further includes:
a housing defining an internal compartment and a top face, the top face forming an opening; and
a flexible substrate having at least one circuitry trace, a front, and a back, the flexible substrate being disposed within the compartment such that the back is exposed relative to the opening in the top face;
wherein the first and second temperature sensors are electrically connected to the circuitry trace and positioned to extend from the front of the substrate opposite the opening.
31. The sensor system of claim 17, wherein the processor is further adapted to control an ultraviolet air treatment device based upon the determined airflow state.
32. A method for detecting airflow within an air handling system including ductwork, the method including:
positioning an airflow sensor within the ductwork, the airflow sensor including a first, heated temperature sensor and a second, baseline temperature sensor;
monitoring signals from the temperature sensors;
determining current temperature readings at the respective temperature sensors based upon the monitored signals; and
determining an airflow state within the air handling system based upon a difference between the determined current temperature readings (DT) and a rate of change in DT.

33. The method of claim 32, further comprising:
generating a temperature rate of change value based upon a difference
between DT and a lag temperature differential value;
wherein determining the presence of airflow includes comparing the
temperature rate of change value with at least one threshold value.
34. The method of claim 33, further comprising:
generating the lag temperature differential value as a function of DT and
a sensor lag parameter.
35. The method of claim 33, further comprising:
a. receiving updated current temperature readings;
b. generating an updated DT value;
c. generating an updated lag temperature differential value; and
d. generating an updated temperature rate of change value.
36. The method of claim 35, wherein the updated lag temperature differential
value is based upon a previous lag temperature differential value.
37. The method of claim 36, wherein the updated lag temperature differential
value is further based upon the updated temperature rate of change value.
38. The method of claim 33, wherein determining an airflow state further
includes:
comparing the temperature rate of change value with a first threshold
value to determine if airflow is not present;
comparing the temperature rate of change value with a second threshold
value to determine if airflow is present.

wherein airflow is designated as being present as a function of whether the current temperature differential value is less than the threshold value.

45. The method of claim 32, further comprising providing an airflow sensor including:

a housing defining an internal compartment and a top face, the top face forming an opening; and

a flexible substrate having at least one circuitry trace, a front, and a back, the flexible substrate being disposed within the compartment such that the back is exposed relative to the opening in the top face;

wherein the first and second temperature sensors are electrically connected to the circuitry trace and positioned to extend from the front of the substrate opposite the opening.

46. The method of claim 32, further comprising:
signaling the determined airflow state to an ultraviolet air treatment device.